

## REMARKS

### Claim Objections 35 U.S.C. § 112, second paragraph

The Examiner has rejected claims 1, 4-12, 18, 20-23, and 25-33 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention.

The Examiner has rejected claims 1, 4-12, 18, 20-23, and 25-33 under 35 U.S.C. § 112, second paragraph, as being incomplete for omitting essential structural cooperative relationships of elements, such omission amounting to a gap between the necessary structural connections. See MPEP § 2172.01. The omitted structural cooperative relationships are: Applicants' claim to relative height or vertical positions is not elaborated with respect to a datum.

Applicants have amended independent claims 1, 25, and 31 to remove the structural cooperative relationships of elements rejected by the Examiner.

Claims 4-12, 18, 20-23 are dependent on claim 1.

Claims 26-30 are dependent on claim 25.

Claims 32-33 are dependent on claim 31.

In view of the foregoing, Applicants respectfully request the Examiner to withdraw the rejections to claims 1, 4-12, 18, 20-23, and 25-33 under 35 U.S.C. §112. second paragraph for being indefinite and incomplete.

Claim Rejections 35 U.S.C. § 103 (a)

Claims 1, 4-12, 18-20, 25, and 27-31

The Examiner has rejected claims 1, 4-12, 18-20, 25, and 27-31 under 35 U.S.C. §103 (a) as being unpatentable over Casey, Jr. et al. (US 6,042,738) as demonstrated by Baum, Aaron Wolf et al. (US 5,684,360 A) in view of Parker, Norman W. et al. (US 4,818,872 A) and Fuji, Eiji et al. (US 5,876,504 A).

Applicants respectfully disagree with the Examiner. Applicants have amended independent claims 1, 25, and 31.

Independent claim 1, as amended, of Applicants' claimed invention, claims an apparatus (400) comprising: a holder (420) to mount a substrate (410); a stage (430) disposed below said holder; an imaging system (440) disposed at a first height above an opaque defect (405) on said substrate, said imaging system including an electron column; a gas delivery system (450) comprising a nozzle with a diameter of 100-300 microns disposed at a second height over said opaque defect at a tilt angle of 45-70 degrees from vertical, a distance of 50-150 microns, and an angular dispersion of 5-25 degrees to dispense a reactant gas and a carrier gas from a reservoir; and an electron scanning delivery system (460) disposed at a third height over said opaque defect to direct electrons in a range of 0.3-3.0 keV towards said reactant gas; a focusing system to highly focus said electrons into an electron beam having a tail diameter of 5-125 nanometers on said opaque defect; a monitoring means for a secondary electron current that interacts with said reactant gas; and a detecting means for an endpoint of a chemical etch of said opaque defect. See Figure 4. Also, see paragraphs [0047]-[0049] and [0054]-[0057] of U.S. Patent Publication 2003/0000921 A1.

Independent claim 25, as amended, of Applicants' claimed invention, claims an apparatus (400) for repairing an opaque defect (405) on a mask (410) without ion implantation or knock-on of atoms comprising: a chamber (470); a stage (430) disposed in said chamber; a holder (420) disposed over said stage; a mask disposed over said holder; an opaque defect disposed on said mask; an imaging system (440) disposed at a first height directly above said opaque defect, said imaging system including an electron column; a gas delivery system (450) disposed at a second height and a tilt angle over said opaque defect; an electron scanning delivery system (460) disposed at a third height over said opaque defect; electrons disposed over said opaque defect, wherein said electrons interact with a gas that is adsorbed and dissociated on said opaque defect without damaging underlying layers; a monitoring means for a secondary electron current that interacts with said gas; a detecting means for an endpoint of a chemical etch of said opaque defect; and a pumping system disposed in said chamber to evacuate volatile byproducts. See Figure 4. Also, see paragraphs [0047]-[0049] and [0054]-[0057] of U.S. Patent Publication 2003/0000921 A1.

Independent claim 31, as amended, of Applicants' claimed invention, claims a mask repair system (400) comprising: a chamber (470), said chamber to hold a mask (410); an imaging system (440) disposed in said chamber at a first height to locate an opaque defect (405) on said mask, said imaging system including an electron column; a gas delivery system (450) disposed in said chamber at a second height and a tilt angle to dispense one or more gases from reservoirs through nozzles towards said opaque defect; and an electron scanning delivery system (460) disposed in said chamber at a third height to provide a highly focused beam of electrons with an electron beam size smaller than 30% of smallest critical defect to interact with said one or more gases adsorbed and dissociated over said opaque defect; a monitoring means for a secondary electron current that interacts with said one or more gases; and a detecting means for an endpoint of a chemical etching of

said opaque defect. See Figure 4. Also, see paragraphs [0047]-[0049] and [0054]-[0057] of U.S. Patent Publication 2003/0000921 A1.

The four references cited by the Examiner fail to teach an apparatus comprising: an imaging system including an electron column, a specific configuration of a gas delivery system, a highly focusing system for the electrons, a particular state of the electrons, a means to monitor a secondary electron current, and a means to detect an endpoint of a chemical etch of an opaque defect. Thus, combination of the apparatus taught by the four references cited by the Examiner, even if possible, would still not produce the apparatus of Applicants' claimed invention, as claimed in independent claim 1. Consequently, Applicants' claimed invention, as claimed in independent claim 1, would not have been obvious to one of ordinary skill in the art of fabricating semiconductors at the time the invention was made.

The four references cited by the Examiner fail to teach an apparatus for repairing an opaque defect on a mask without ion implantation or knock-on of atoms comprising: an imaging system including an electron column, a specific configuration of a gas delivery system, a means to monitor a secondary electron current, and a means to detect an endpoint of a chemical etch of an opaque defect. Thus, combination of the apparatus taught by the four references cited by the Examiner, even if possible, would still not produce the apparatus of Applicants' claimed invention, as claimed in independent claim 25. Consequently, Applicants' claimed invention, as claimed in independent claim 25, would not have been obvious to one of ordinary skill in the art of fabricating semiconductors at the time the invention was made.

The four references cited by the Examiner fail to teach a mask repair system comprising: an imaging system including an electron column, a specific configuration of a gas delivery system, a highly focused beam of electrons, a particular electron beam size, a means to monitor a secondary electron current, and a means to detect an endpoint of a chemical etch of an opaque defect. Thus,

combination of the apparatus taught by the four references cited by the Examiner, even if possible, would still not produce the apparatus of Applicants' claimed invention, as claimed in independent claim 31. Consequently, Applicants' claimed invention, as claimed in independent claim 31, would not have been obvious to one of ordinary skill in the art of fabricating semiconductors at the time the invention was made.

Claims 4-12, 18-20 are dependent on claim 1.

Claims 27-30 are dependent on claim 25.

Since combination of the apparatus taught by the four cited references, even if possible, would also still not produce the apparatus as claimed in independent claims 1, 25, or 31 of Applicants' claimed invention, the apparatus claimed in dependent claims 4-12, 18-20, and 27-30 of Applicants' claimed invention would also not have been obvious to one of ordinary skill in the art of semiconductors at the time the invention was made.

In view of the foregoing, Applicants respectfully request the Examiner to withdraw the rejections to pending claims 1, 4-12, 18-20, 25, and 27-31 under 35 U.S.C. §103 (a).

### Claim 31

The Examiner has rejected claim 31 under 35 U.S.C. §103 (a) as being unpatentable over Casey, Jr. et al. (US 6,042,738) as demonstrated by Baum, Aaron Wolf et al. (US 5,684,360 A) in view of Parker, Norman W. et al. (US 4,818,872 A).

Applicants respectfully disagree with the Examiner. Applicants have amended independent claim 31.

Independent claim 31, as amended, of Applicants' claimed invention, claims a mask repair system (400) comprising: a chamber (470), said chamber to hold a mask

(410); an imaging system (440) disposed in said chamber at a first height to locate an opaque defect (405) on said mask, said imaging system including an electron column; a gas delivery system (450) disposed in said chamber at a second height and a tilt angle to dispense one or more gases from reservoirs through nozzles towards said opaque defect; and an electron scanning delivery system (460) disposed in said chamber at a third height to provide a highly focused beam of electrons with an electron beam size smaller than 30% of smallest critical defect to interact with said one or more gases adsorbed and dissociated over said opaque defect; a monitoring means for a secondary electron current that interacts with said one or more gases; and a detecting means for an endpoint of a chemical etching of said opaque defect. See Figure 4. Also, see paragraphs [0047]-[0049] and [0054]-[0057] of U.S. Patent Publication 2003/0000921 A1.

The three references cited by the Examiner fail to teach a mask repair system comprising: an imaging system including an electron column, a specific configuration of a gas delivery system, a highly focused beam of electrons, a particular electron beam size, a means to monitor a secondary electron current, and a means to detect an endpoint of a chemical etch of an opaque defect. Thus, combination of the apparatus taught by the three references cited by the Examiner, even if possible, would still not produce the apparatus of Applicants' claimed invention, as claimed in independent claim 31. Consequently, Applicants' claimed invention, as claimed in independent claim 31, would not have been obvious to one of ordinary skill in the art of fabricating semiconductors at the time the invention was made.

In view of the foregoing, Applicants respectfully request the Examiner to withdraw the rejections to pending claim 31 under 35 U.S.C. §103 (a).

### Claims 25 and 27-30

The Examiner has rejected claims 25 and 27-30 under 35 U.S.C. §103 (a) as being unpatentable over Casey, Jr. et al. (US 6,042,738) as demonstrated by Baum, Aaron Wolf et al. (US 5,684,360 A) in view of Parker, Norman W. et al. (US 4,818,872 A).

Applicants respectfully disagree with the Examiner. Applicants have amended independent claim 25.

Independent claim 25, as amended, of Applicants' claimed invention, claims an apparatus (400) for repairing an opaque defect (405) on a mask (410) without ion implantation or knock-on of atoms comprising: a chamber (470); a stage (430) disposed in said chamber; a holder (420) disposed over said stage; a mask disposed over said holder; an opaque defect disposed on said mask; an imaging system (440) disposed at a first height directly above said opaque defect, said imaging system including an electron column; a gas delivery system (450) disposed at a second height and a tilt angle over said opaque defect; an electron scanning delivery system (460) disposed at a third height over said opaque defect; electrons disposed over said opaque defect, wherein said electrons interact with a gas that is adsorbed and dissociated on said opaque defect without damaging underlying layers; a monitoring means for a secondary electron current that interacts with said gas; a detecting means for an endpoint of a chemical etch of said opaque defect; and a pumping system disposed in said chamber to evacuate volatile byproducts. See Figure 4. Also, see paragraphs [0047]-[0049] and [0054]-[0057] of U.S. Patent Publication 2003/0000921 A1.

The three references cited by the Examiner fail to teach an apparatus for repairing an opaque defect on a mask without ion implantation or knock-on of atoms comprising: an imaging system including an electron column, a specific

configuration of a gas delivery system, a means to monitor a secondary electron current, and a means to detect an endpoint of a chemical etch of an opaque defect. Thus, combination of the apparatus taught by the three references cited by the Examiner, even if possible, would still not produce the apparatus of Applicants' claimed invention, as claimed in independent claim 25. Consequently, Applicants' claimed invention, as claimed in independent claim 25, would not have been obvious to one of ordinary skill in the art of fabricating semiconductors at the time the invention was made.

Claims 27-30 are dependent on claim 25.

Since combination of the apparatus taught by the three cited references, even if possible, would also still not produce the apparatus as claimed in independent claim 25 of Applicants' claimed invention, the apparatus claimed in dependent claims 27-30 of Applicants' claimed invention would also not have been obvious to one of ordinary skill in the art of semiconductors at the time the invention was made.

In view of the foregoing, Applicants respectfully request the Examiner to withdraw the rejections to pending claims 25 and 27-30 under 35 U.S.C. §103 (a).

#### Claims 21-24, 26, 32, and 33

The Examiner has rejected claims 21-24, 26, 32, and 33 under 35 U.S.C. §103 (a) as being unpatentable over Casey, Jr. et al. (US 6,042,738) as demonstrated by Baum, Aaron Wolf et al. (US 5,684,360 A) and Fuji, Eiji et al. (US 5,876,504 A) in view of Parker, Norman W. et al. (US 4,818,872 A).

Applicants respectfully disagree with the Examiner. Applicants have amended independent claims 1, 25, and 31.

Independent claim 1, as amended, of Applicants' claimed invention, claims an apparatus (400) comprising: a holder (420) to mount a substrate (410); a stage (430) disposed below said holder; an imaging system (440) disposed at a first height above an opaque defect (405) on said substrate, said imaging system including an electron column; a gas delivery system (450) comprising a nozzle with a diameter of 100-300 microns disposed at a second height over said opaque defect at a tilt angle of 45-70 degrees from vertical, a distance of 50-150 microns, and an angular dispersion of 5-25 degrees to dispense a reactant gas and a carrier gas from a reservoir; and an electron scanning delivery system (460) disposed at a third height over said opaque defect to direct electrons in a range of 0.3-3.0 keV towards said reactant gas; a focusing system to highly focus said electrons into an electron beam having a tail diameter of 5-125 nanometers on said opaque defect; a monitoring means for a secondary electron current that interacts with said reactant gas; and a detecting means for an endpoint of a chemical etch of said opaque defect. See Figure 4. Also, see paragraphs [0047]-[0049] and [0054]-[0057] of U.S. Patent Publication 2003/0000921 A1.

Independent claim 25, as amended, of Applicants' claimed invention, claims an apparatus (400) for repairing an opaque defect (405) on a mask (410) without ion implantation or knock-on of atoms comprising: a chamber (470); a stage (430) disposed in said chamber; a holder (420) disposed over said stage; a mask disposed over said holder; an opaque defect disposed on said mask; an imaging system (440) disposed at a first height directly above said opaque defect, said imaging system including an electron column; a gas delivery system (450) disposed at a second height and a tilt angle over said opaque defect; an electron scanning delivery system (460) disposed at a third height over said opaque defect; electrons disposed over said opaque defect, wherein said electrons interact with a gas that is adsorbed and dissociated on said opaque defect without damaging underlying layers; a monitoring means for a secondary electron current that interacts with said gas; a detecting means for an endpoint of a chemical etch of said opaque defect; and a

pumping system disposed in said chamber to evacuate volatile byproducts. See Figure 4. Also, see paragraphs [0047]-[0049] and [0054]-[0057] of U.S. Patent Publication 2003/0000921 A1.

Independent claim 31, as amended, of Applicants' claimed invention, claims a mask repair system (400) comprising: a chamber (470), said chamber to hold a mask (410); an imaging system (440) disposed in said chamber at a first height to locate an opaque defect (405) on said mask, said imaging system including an electron column; a gas delivery system (450) disposed in said chamber at a second height and a tilt angle to dispense one or more gases from reservoirs through nozzles towards said opaque defect; and an electron scanning delivery system (460) disposed in said chamber at a third height to provide a highly focused beam of electrons with an electron beam size smaller than 30% of smallest critical defect to interact with said one or more gases adsorbed and dissociated over said opaque defect; a monitoring means for a secondary electron current that interacts with said one or more gases; and a detecting means for an endpoint of a chemical etching of said opaque defect. See Figure 4. Also, see paragraphs [0047]-[0049] and [0054]-[0057] of U.S. Patent Publication 2003/0000921 A1.

The four references cited by the Examiner fail to teach an apparatus comprising: an imaging system including an electron column, a specific configuration of a gas delivery system, a highly focusing system for the electrons, a particular state of the electrons, a means to monitor a secondary electron current, and a means to detect an endpoint of a chemical etch of an opaque defect. Thus, combination of the apparatus taught by the four references cited by the Examiner, even if possible, would still not produce the apparatus of Applicants' claimed invention, as claimed in independent claim 1. Consequently, Applicants' claimed invention, as claimed in independent claim 1, would not have been obvious to one of ordinary skill in the art of fabricating semiconductors at the time the invention was made.

The four references cited by the Examiner fail to teach an apparatus for repairing an opaque defect on a mask without ion implantation or knock-on of atoms comprising: an imaging system including an electron column, a specific configuration of a gas delivery system, a means to monitor a secondary electron current, and a means to detect an endpoint of a chemical etch of an opaque defect. Thus, combination of the apparatus taught by the four references cited by the Examiner, even if possible, would still not produce the apparatus of Applicants' claimed invention, as claimed in independent claim 25. Consequently, Applicants' claimed invention, as claimed in independent claim 25, would not have been obvious to one of ordinary skill in the art of fabricating semiconductors at the time the invention was made.

The four references cited by the Examiner fail to teach a mask repair system comprising: an imaging system including an electron column, a specific configuration of a gas delivery system, a highly focused beam of electrons, a particular electron beam size, a means to monitor a secondary electron current, and a means to detect an endpoint of a chemical etch of an opaque defect. Thus, combination of the apparatus taught by the four references cited by the Examiner, even if possible, would still not produce the apparatus of Applicants' claimed invention, as claimed in independent claim 31. Consequently, Applicants' claimed invention, as claimed in independent claim 31, would not have been obvious to one of ordinary skill in the art of fabricating semiconductors at the time the invention was made.

Claims 21-24 are dependent on claim 1.

Claim 26 is dependent on claim 25.

Claims 32 and 33 are dependent on claim 31.

Since combination of the apparatus taught by the four cited references, even if possible, would also still not produce the apparatus as claimed in independent claims 1, 25, or 31 of Applicants' claimed invention, the apparatus claimed in dependent claims 21-24, 26, 32, and 33 of Applicants' claimed invention would also

not have been obvious to one of ordinary skill in the art of semiconductors at the time the invention was made.

In view of the foregoing, Applicants respectfully request the Examiner to withdraw the rejections to pending claims 21-24, 26, 32, and 33 under 35 U.S.C. §103 (a).

### Conclusion

Applicants believe that all claims pending, including claims 1, 4-12, 18, 20-23, and 25-33, are now in condition for allowance so such action is earnestly solicited at the earliest possible date.

Pursuant to 37 C.F.R. 1.136 (a) (3), Applicant hereby requests and authorizes the U.S. Patent and Trademark Office to treat any concurrent or future reply that requires a petition for extension of time as incorporating a petition for extension of time for the appropriate length of time.

Should there be any additional charge or fee, including a Request for Continued Examination, an extension of time fee, or other fees under 37 C.F.R. 1.16 and 1.17, please charge Deposit Account No. 50-0221.

If a telephone interview would in any way expedite the prosecution of this application, the Examiner is invited to contact the undersigned at (408) 653-7897.

Respectfully submitted,  
INTEL CORPORATION

Dated: January 19, 2009      /George Chen/

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